High heat-resistant Lithium-ion Capacitor
Reliability cultivated with auto parts expanding to a variety of industries
JTEKT High heat-resistant Lithium-ion Capacitor

Original technologies realizing world-first wide operating temperature range from -40 to 85°C.
High installation flexibility by being cooling-free satisfies a wide variety of industries’ needs.

JTEKT
Only One Technology

Wide operating temperature range
-40 to 85°C

- High capacitance
- Saenness
- Supports low temperatures
- Supports high temperatures
- Supports large current
- Compact/ lightweight

Compacts by being cooling-free
Contributes to product downsizing with a wide operating temperature range.

<table>
<thead>
<tr>
<th>Ambient temperature, °C</th>
<th>-40</th>
<th>-20</th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional product</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithium-ion battery/capacitor</td>
<td>Using cooling system</td>
<td>Energy loss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Double Layer Capacitor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JTEKT High heat-resistant Lithium-ion Capacitor</td>
<td>Regular use range (2.2 to 3.8V)</td>
<td>Restricted voltage range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithium-ion battery/capacitor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Application in a variety of industrial fields

Application expands to various industrial fields that require wide temperature range usage

- System cost reduction
- Higher system efficiency (elimination of cooling/heating power)
- Maintenance-free
- Downsizing
- Improve installation flexibility

Energy saving/Regeneration

Power assist

Main power supply

Power stabilization

Backup power supply

Construction machinery

Agricultural machinery

Aircraft

Trains

Motorcycles

Satellites

Medical equipment

Automobiles

Wind power generators/Solar power generators

Energy saving/Regeneration

Power assist

Main power supply

Power stabilization

Backup power supply
Supports high temperatures

Highest heat resistance in the industry
Able to be used in ranges difficult to date due to the need for cooling.

Comparison of float charging resistance (85°C, 3.6V)

<table>
<thead>
<tr>
<th>JTEKT</th>
<th>1500 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional product</td>
<td>100 h</td>
</tr>
</tbody>
</table>

Conductivity

Criteria (IEC62813-2015)

Good

Also supports self-heat generation during large current charge/discharge

- Also shows excellent durability against deterioration caused by self-heat generation during large current charge/discharge.
- Achieves a compact system through elimination of cooling and reduction of cooling space.

Self-heat generation behavior during large current charge/discharge (capacitor simple lamination with NO cell clearance)

Heat-resistance of JTEKT High heat-resistant Lithium-ion Capacitor (85°C)

Exhibiting stable performance even in high temperature environments

Stable output and capacitance

Comparison by preservation test in thermostatic chamber

Test conditions:
- Temperature: 100°C
- Cell voltage: 3.6V
- Test time: 150min

Test video

Stable operation also possible in 100°C environments by limiting operating upper limit voltage.

[Test overview]
The High heat-resistant Lithium-ion Capacitor was used as the power source of a toy racing machine. Achieved stable current supply even in boiling water.

View video here
https://www.youtube.com/watch?v=xWFllsBGqos

Excellent heat resistance contributes to high output and downsizing of the system

No cooling required even on systems with large current

Supports high temperatures

Good

Applications

This product is anticipated to be utilized in a broad range of applications requiring large current.
(Trains, large trucks, large construction machinery, etc.)
Also offers excellent low temperature performance

- Can be used in extremely low temperatures not previously possible.
- Large electric current can be supplied stably.

Comparison of internal resistance increase in low temperatures

Test conditions:
Conform to IEC62823-2015

Capacitor capacitance/temperature and charge/discharge current (recommended value)

Large current supply possible even in low temperature environments

Applications

Since JTEKT High heat-resistant Lithium-ion Capacitor can supply the necessary large current even in low temperature environments, it is to be used in various fields.
(e.g. snowmobiles, snow plows, deep-freeze storage, power source for equipment in extremely cold regions)

Test video

A stable supply of large current is possible as the electrolyte liquid does not freeze even at -40°C.

[Test overview]
Electrolyte liquid was stored in the glass jars on the left and right, and cooled to -40°C. The conventional electrolyte liquid (right) froze, however JTEKT’s electrolyte liquid (left) did not.

View video here
https://www.youtube.com/watch?v=hnlLmzz8c8Ro
Various test data

Long-term durability test (repeated charge/discharge)

Self-discharging property test

Nail penetration test

Product specifications

<table>
<thead>
<tr>
<th>Capacitance series</th>
<th>500F</th>
<th>1000F</th>
<th>1500F</th>
<th>2000F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating voltage range</td>
<td>2.2V to 3.8V</td>
<td>2.2V to 3.8V</td>
<td>2.2V to 3.8V</td>
<td>2.2V to 3.8V</td>
</tr>
<tr>
<td>Internal resistance</td>
<td>3.6</td>
<td>1.8</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Operating voltage: 2.2V to 3.8V</td>
<td>Operating voltage: 2.2V to 3.8V</td>
<td>Operating voltage: -40 to 85°C</td>
<td>Operating voltage: -40 to 85°C</td>
</tr>
<tr>
<td>Ref. Energy capacity</td>
<td>250</td>
<td>500</td>
<td>750</td>
<td>1000</td>
</tr>
<tr>
<td>Ref. Cell weight</td>
<td>80</td>
<td>160</td>
<td>240</td>
<td>320</td>
</tr>
<tr>
<td>Ref. Cell size</td>
<td>X (mm)</td>
<td>Y (mm)</td>
<td>Z (mm)</td>
<td></td>
</tr>
<tr>
<td>Ref. Cell volume</td>
<td>63</td>
<td>63</td>
<td>123</td>
<td>123</td>
</tr>
<tr>
<td>Internal resistance</td>
<td>55</td>
<td>97</td>
<td>135</td>
<td>188</td>
</tr>
<tr>
<td>Capacitance</td>
<td>111</td>
<td>111</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td>Ref. Cell volume (cm³)</td>
<td>7.3</td>
<td>14.4</td>
<td>10.2</td>
<td>14.4</td>
</tr>
</tbody>
</table>

1) After 1,000h float-charging test (20ºC, 3.8V) Internal resistance increase rate: 20% or less. Capacitance reduction rate: 10% or less.
2) After 1,000h float-charging test (120ºC, 3.8V) Internal resistance increase rate: 30% or less. Capacitance reduction rate: 10% or less.

Nail penetration test performed based on conforming to GB/T31485-2015
No fire on the High heat-resistant Lithium-ion Capacitor

National standard of the People’s Republic of China

Required scope (specification scope) - No fire

<table>
<thead>
<tr>
<th>No.</th>
<th>Test name</th>
<th>Number</th>
<th>Voltage deviation</th>
<th>Current deviation</th>
<th>Temperature deviation</th>
<th>Humidity deviation</th>
<th>Other</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overcharging</td>
<td>1</td>
<td>±0.5%</td>
<td>±1%</td>
<td>±5°C</td>
<td>±40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Short circuit</td>
<td>2</td>
<td>±2%</td>
<td>±2%</td>
<td>±10°C</td>
<td>±50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Heating</td>
<td>3</td>
<td>±5%</td>
<td>±3%</td>
<td>±15°C</td>
<td>±60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Crushing</td>
<td>4</td>
<td>±1%</td>
<td>±1%</td>
<td>±2°C</td>
<td>±20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nail penetration</td>
<td>5</td>
<td>±2%</td>
<td>±2%</td>
<td>±1°C</td>
<td>±30%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reproduction of this catalog without written consent is strictly prohibited.

The contents of this catalog are subject to change without prior notice. Every possible effort has been made to ensure that the data herein is correct; however, JTEKT cannot assume responsibility for any errors or omissions.